

AN EVALUATION OF SENSORY QUALITY OF BEEF MUSCLES USING CONSUMER RESPONSES AND RAPID EVAPORATIVE IONISATION MASS SPECTROMETRY (REIMS) ANALYSIS

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I. INTRODUCTION

Sensory evaluation of meat measures consumer reactions to product quality. Common traits used in evaluating sensory quality of red meat include tenderness, juiciness, flavour, and overall liking which are directly influenced by animal age, breed, sex, feed, and post-slaughter conditions such as ageing and hang method [1]. Rapid Evaporative Ionisation Mass Spectrometry (REIMS) is used as a powerful analytical tool in food fraud and adulteration of meat products [2]. More recently, REIMS has been used to determine the sensory and nutritional quality parameters of beef [3]. Studies assessing and linking lipidomic fractions identified from REIMS output and consumer responses to beef sensory quality are limited. Therefore, this experiment used REIMS and advanced chemometric modelling to uniquely connect lipidomic data from raw beef and consumer sensory scores.

II. MATERIALS AND METHODS

samples (N=149) were collected from 31 animals after 7-day maturation post-slaughter. Carcasses including 12 breeds and grass-based feeding systems, were hung using the Achilles Tendon (AT) method across three sites in Wales, UK. Four muscle samples were collected including: Oyster blade (OYS; n=32), Tenderloin (TDR; n=32), Ribeye (EYE; n=32), Striploin (STR; n=53). Consumer taste panels were conducted at 18 different locations to assess sensory quality responses. Samples were analysed using REIMS technology. Samples were burned using a monopolar electrosurgical "iKnife" attached to the REIMS system (Waters REIMS source (Waters Corporation, Wilmslow, UK); a Xevo G2-XS QToF Mass spectrometer (Waters Corporation, Wilmslow, UK). Data were performed in sensitivity mode with continuum data acquisition in negative ionisation mode within a mass range of m/z 50-1200, with a scan speed of 2 scans per second. Each sample (1 cm in thickness) was analysed four times. REIMS data was extracted using the Abstract model builder software (Waters Research Centre, Budapest, Hungary). The proposed REIMS data processing flow for evaluating the subjective palatability parameters is presented, comprising of pre-treatment strategy (mass bin = 0.25, mass range = 50 m/z – 1200 m/z, and pre-processing method (Log10 + mean centre)) and Partial Least Squares regression - Variable Importance in Projection (PLSR-VIP).

III. RESULTS AND DISCUSSION

Consumer panels identified tenderness responses at 0.21 (21%) at the unsatisfactory/good every day (3*) boundary, 0.29 at the 3* or better than everyday (4*) and 0.26 at the 4* or Premium (5*). Similarly, for flavour 0.11, 0.04, 0.21 were reported for 3*, 3*/4* and 4*/5* boundaries, respectively. The Partial Least Squares - Variable Importance in Projection (PLS-VIP) score plots for different palatability parameters exhibit clear discrimination (Figure 1). All R² values were greater than 80%, regardless of whether Leave-One-Out-Cross-Validation (LOOCV) or 10-fold CV was used (Table 1). Furthermore, the Relative Percentage Difference (RPD) values in the cross-validation group were also found to be

greater than 2, suggesting the models in the cross-validation group were of a moderate level of performance.

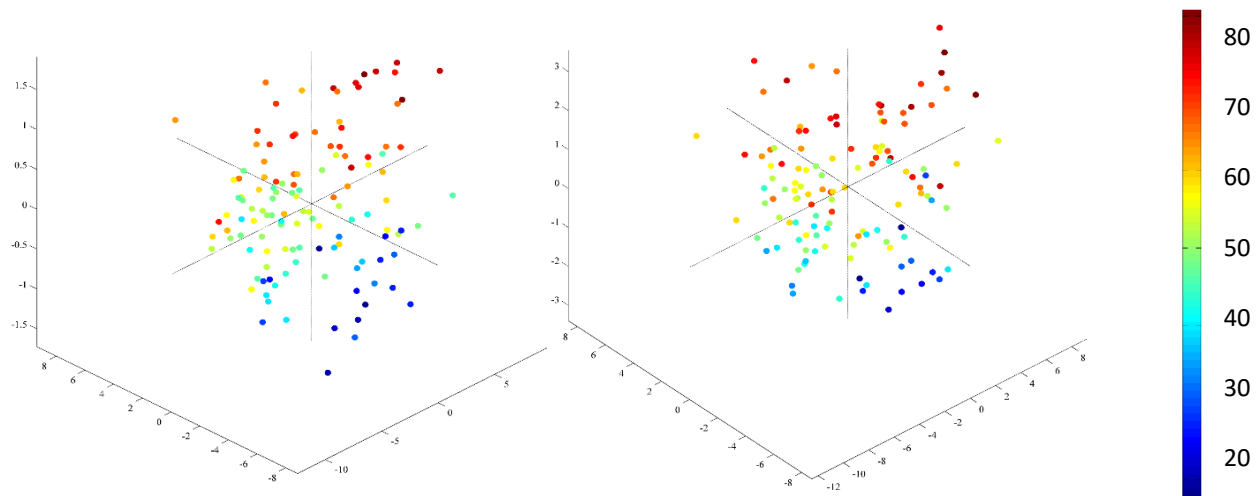


Figure 1. The score plot of the PLS-VIP performed on the selected data pre-treatment, coloured by flavour score (left) and tenderness (right)

Table 1. Regression results using data pre-treatment strategy +VIP-PLS for all four muscles analysed.

| Consumer response | R ² Cal | RMSEC | R ² CV | RMSECV | R ² Val | RMSEP |
|---------------------|--------------------|-------|-------------------|--------|--------------------|-------|
| Tender | 99% | 2.14 | 81% | 9.26 | 1% | 19.72 |
| O/all like | 99% | 1.76 | 83% | 7.82 | 0% | 6.82 |
| Flavour | 99% | 1.61 | 82% | 7.06 | 1% | 4.74 |
| Juicy | 98% | 1.82 | 83% | 6.97 | 3% | 5.59 |
| Satisfaction | 97% | 0.11 | 83% | 0.28 | 0% | 0.69 |
| MQ4 | 99% | 1.6 | 82% | 7.75 | 0% | 7.01 |

IV. CONCLUSION

This study has demonstrated that REIMS can detect and categorise chemical information related to sensory meat quality, which can be used to predict the flavour and tenderness of meat. Overall, this study has identified the potential of REIMS as a complementary tool for evaluating meat palatability, offering a faster, more accurate, and cost-effective method for the meat industry. Validation of these results through extensive sampling and analysis is required.

ACKNOWLEDGEMENTS

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